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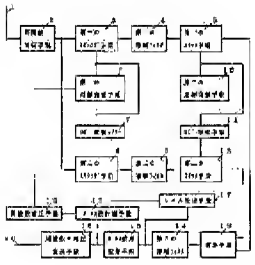
(54) FSK RECEPTION DEVICE



(57)Abstract:
PURPOSE: To detect deviation of an intermediate frequency signal with simple constitution and control a local oscillation frequency by correcting an oscillation frequency in the direction wherein the difference between the counting result of a pulse quantity measuring means and the predetermined reference number of pulses becomes 0.
CONSTITUTION: When the output of a band-pass filter 14 is larger than a specific level, a detection means 17 generates an output and the pulse quantity measuring means 18 is actuated. Then the number of pulses outputted from a pulse waveform shaping means 15 is measured for a certain predetermined time. Here, the shaping means 15 amplifies the

output of the band-pass filter 14 and converts it into a pulse waveform by using a comparator. A frequency-voltage converting means 16 converts the frequency variation of the input into voltage variation and imposes FSK demodulation, and the demodulated signal is outputted to an output terminal 20. The number of pulses measured by the measuring means 18, on the other hand, is inputted to a frequency correcting means 19 to calculate an error in the predetermined reference number of pulses. Then a control voltage corresponding to the error is generated at the filter 14 to eliminate the error.

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CLAIMS

[Claim(s)]
[Claim 1] with a local oscillation means to be the FSK receiving set to which it restores after changing the FSK modulating signal by which frequency modulation was carried out by the signal including the bit synchronization signal which goes away, and which is transmitted in advance of information since it ****** into an intermediate frequency signal zero, and to output a local oscillation signal with 1 A mixing means to mix said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A pulse-shape plastic surgery means to change said intermediate frequency signal into pulse shape, and a pulse number measurement means to measure between a certain time amount which defined beforehand the pulse number from said pulse-shape plastic surgery means, The FSK receiving set which consisted of frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the number of reference pulses beforehand determined as the measurement result in said pulse number measurement means.
[Claim 2] with a local oscillation means to be the FSK receiving set to which it restores after changing the FSK modulating signal by which frequency modulation was carried out by the signal including the bit synchronization signal which goes away, and which is transmitted in advance of information since it ****** into an intermediate frequency signal zero, and to output a local oscillation signal with 1 A mixing means to mix said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A pulse-shape plastic surgery means to change said intermediate frequency signal into pulse shape, and a time amount measurement means to measure time amount until the pulse number from said pulse-shape plastic surgery means reaches the number defined beforehand, The FSK receiving set which consisted of frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the conventional time beforehand determined as the measurement result in said time amount measurement means.
[Claim 3] It is the FSK receiving set to which it restores after changing the FSK modulating signal by which frequency modulation was carried out by the signal including the bit synchronization signal which goes away, and which is transmitted in advance of information since it ****** into an intermediate frequency signal zero with 1. A level

detection means to detect whether it is more than level with the receiving level of said FSK modulating signal, A mixing means to mix a local oscillation means to output a local oscillation signal, and said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A pulse number measurement means to measure between a certain time amount which defined beforehand the pulse number from said pulse-shape plastic surgery means when judged with it being more than the level that has the receiving level of the FSK modulating signal with a pulse-shape plastic surgery means to change said intermediate frequency signal into pulse shape, and said level detection means, The FSK receiving set which consisted of frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the number of reference pulses beforehand determined as the measurement result in said pulse number measurement means.
[Claim 4] It is the FSK receiving set to which it restores after changing the FSK modulating signal by which frequency modulation was carried out by the signal including the bit synchronization signal which goes away, and which is transmitted in advance of information since it ****** into an intermediate frequency signal zero with 1. A level detection means to detect whether it is more than level with the receiving level of said FSK modulating signal, A mixing means to mix a local oscillation means to output a local oscillation signal, and said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A pulse-shape plastic surgery means to change said intermediate frequency signal into pulse shape, A time amount measurement means to measure time amount when judged with it being more than the level that has the receiving level of the FSK modulating signal with said level detection means, until the pulse number from said pulse-shape plastic surgery means reaches the number defined beforehand, The FSK receiving set which consisted of frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the conventional time beforehand determined as the measurement result in said time amount measurement means.
[Claim 5] It is the FSK receiving set to which it restores after changing the FSK modulating signal by which frequency modulation was carried out by the signal including the bit synchronization signal which goes away, and which is transmitted in advance of information since it ****** into an intermediate frequency signal zero with 1. A level detection means to detect whether it is more than level with the

receiving level of said FSK modulating signal, A mixing means to mix a local oscillation means to output a local oscillation signal, and said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A frequency-electrical-potential-difference conversion means to output the electrical potential difference according to the frequency of said **********, An average voltage-output means to output the average electrical potential difference of the period which has the output voltage from said frequency-electrical-potential-difference conversion means when judged with it being more than the level that has the receiving level of the FSK modulating signal with said level detection means, The FSK receiving set which consisted of frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the reference voltage beforehand determined as the electrical potential difference from an average voltage-output means.

[Claim 6] The first mixing means which takes out the signal with which the FSK receiving set serves as a frequency of the difference of the signal from the first local oscillation means and said first local oscillation means, and the FSK modulating signal, The second mixing means which takes out the signal used as the frequency of the difference of the signal which carried out the phase shift of the signal from said first local oscillation means, and the FSK modulating signal, The first low-pass cutoff filter which considers the signal from said first mixing means as an input, The second low-pass cutoff filter which considers the signal from said second mixing means as an input, Second local oscillation means to generate the square wave signal which continued in time, and the first switching means which switches the signal from said first low-pass cutoff filter with the square wave signal from said second local oscillation means, The second switching means which switches the signal from said second low-pass cutoff filter with the square wave signal which carried out the phase shift of the square wave signal from said second local oscillation means, An operation means to add or subtract the output signal of said first switching means, and the output signal of said second switching means, The band-pass filter prepared in the preceding paragraph or the latter part of said operation means, The FSK receiving set according to claim 1, 2, 3, 4, or 5 which consisted of frequency-electrical-potential-difference conversion means to generate the electrical potential difference according to the frequency of the output signal of said band-pass filter, and made the output of said band-pass filter the intermediate frequency signal.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates mainly to the FSK receiving set of a direct conversion method.
[0002]
[Description of the Prior Art] The single superheterodyne method and double superheterodyne method to which it restores after changing into an intermediate frequency signal the FSK modulating signal generally received as a FSK receiving method in radio are used. Moreover, there is a direct conversion method considering the band-pass filter for removing the band-pass filter and adjacent channel signal for removing image frequency as a receiving method which can be constituted from an IC. After changing an input signal into two baseband signaling which intersects perpendicularly by mixing two local oscillation signals and input signals which have a frequency almost equal to the center frequency of an input signal as an example of a direct conversion method, and which intersect perpendicularly, respectively and taking out only the signal of choice with a filter, there is a method to which it changes and restores in intermediate frequency of dozens of kHz. Since a receiving property will get worse if the oscillation frequency stability of a local oscillation means is bad also in which receiving method, there is a FSK receiving set constituted so that an intermediate frequency signal came to the core of a band-pass filter and the oscillation frequency of a local oscillation means might be controlled. Frequency analysis of the reference frequency received as an example of the conventional FSK receiving set which controls such a local oscillation frequency as shown in the "receiving set" of Japanese Patent

Application No. No. 230807 [58 to] is carried out, and there is a thing of a configuration of controlling a local oscillation means based on the result of frequency analysis. moreover, as another example Use the front-end signal sent in advance of an information sign as shown in the "AFC method for the FSK receiving sets" of JP,55-37131,B, constitute an AFC closed loop using the output of a frequency discrimination circuit (= frequency-electrical-potential-difference conversion means), and the oscillation frequency of a local oscillation means is controlled. When reception of a front-end signal is completed, the control voltage of said AFC closed loop is memorized, and there is a thing of a configuration of impressing said memorized control voltage to a local oscillation means by the open loop.

[0003]

[Problem(s) to be Solved by the Invention] However, the approach which used the Fourier transform technique as a frequency-analysis means, and the approach which were able to be located in a line in the filter are used, the analog filter of the digital signal processor of high-speed processing or many was needed, and it was not able to constitute from an above-mentioned conventional FSK receiving set cheaply. moreover, since signalling frequency single as reference frequency or a front-end signal was needed, usually unnecessary single signalling frequency had to be sent before 1 and the bit synchronization signal which goes away zero and which is transmitted in advance of information since it ******, and the technical problem that transmission efficiency was worsened occurred. In the two above-mentioned examples of a citation, it was not clear about the timing which furthermore starts initiation of actuation of a frequency-analysis means, and control of a local oscillation frequency, and it is always necessary to perform frequency-analysis actuation and reception actuation of reference frequency or a front-end signal, and the conventional approach was not able to be adopted as the intermittent FSK receiving system.

[0004] This invention solves the above-mentioned technical problem, and it aims at realizing the FSK receiving set which is an easy configuration, and can detect a gap of the intermediate frequency signal from the core of a band-pass filter, and can control a local oscillation frequency, without attaching an unnecessary additional signal before a bit synchronization signal.

[0005]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the FSK receiving set of this invention with a local oscillation means to be the FSK receiving set to which it restores after

changing the FSK modulating signal by which frequency modulation was carried out by the signal including the bit synchronization signal which goes away, and which is transmitted in advance of information since it ****** into an intermediate frequency signal zero, and to output a local oscillation signal with 1 A mixing means to mix said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A pulse-shape plastic surgery means to change said intermediate frequency signal into pulse shape, and a pulse number measurement means to measure between a certain time amount which defined beforehand the pulse number from said pulse-shape plastic surgery means, It has a frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the number of reference pulses beforehand determined as the measurement result in said pulse number measurement means.

[0006] Moreover, a mixing means to mix a local oscillation means to output a local oscillation signal, and said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A pulse-shape plastic surgery means to change said intermediate frequency signal into pulse shape, and a time amount measurement means to measure time amount until the pulse number from said pulse-shape plastic surgery means reaches the number defined beforehand, It is also the thing equipped with a frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the conventional time beforehand determined as the measurement result in said time amount measurement means.

[0007] Furthermore, a level detection means to detect whether it is more than level with the receiving level of the FSK modulating signal, A mixing means to mix a local oscillation means to output a local oscillation signal, and said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A pulse number measurement means to measure between a certain time amount which defined beforehand the pulse number from said pulse-shape plastic surgery means when judged with it being more than the level that has the receiving level of the FSK modulating signal with a pulse-shape plastic surgery means to change said intermediate frequency signal into pulse shape, and said level detection means, It consists of frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the number of reference pulses beforehand determined

as the measurement result in said pulse number measurement means.
[0008] Moreover, a level detection means to detect whether it is more than level with the receiving level of the FSK modulating signal, A mixing means to mix a local oscillation means to output a local oscillation signal, and said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A pulse-shape plastic surgery means to change said intermediate frequency signal into pulse shape, A time amount measurement means to measure time amount when judged with it being more than the level that has the receiving level of the FSK modulating signal with said level detection means, until the pulse number from said pulse-shape plastic surgery means reaches the number defined beforehand, It consists of frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the conventional time beforehand determined as the measurement result in said time amount measurement means.
[0009] Moreover, a level detection means to detect whether it is more than level with the receiving level of the FSK modulating signal, A mixing means to mix a local oscillation means to output a local oscillation signal, and said local oscillation signal and said FSK modulating signal, and to output an intermediate frequency signal, A frequency-electrical-potential-difference conversion means to output the electrical potential difference according to the frequency of said **********, An average voltage-output means to output the average electrical potential difference of the period which has the output voltage from said frequency-electrical-potential-difference conversion means when judged with it being more than the level that has the receiving level of the FSK modulating signal with said level detection means, It consists of frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the reference voltage beforehand determined as the electrical potential difference from an average voltage-output means.
[0010] Furthermore, the first mixing means which takes out the signal with which the FSK receiving set serves as a frequency of the difference of the signal from the first local oscillation means and said first local oscillation means, and the FSK modulating signal, The second mixing means which takes out the signal used as the frequency of the difference of the signal which carried out the phase shift of the signal from said first local oscillation means, and the FSK modulating signal, The first low-pass cutoff filter which considers the signal from said

first mixing means as an input, The second low-pass cutoff filter which considers the signal from said second mixing means as an input, Second local oscillation means to generate the square wave signal which continued in time, and the first switching means which switches the signal from said first low-pass cutoff filter with the square wave signal from said second local oscillation means, The second switching means which switches the signal from said second low-pass cutoff filter with the square wave signal which carried out the phase shift of the square wave signal from said second local oscillation means, An operation means to add or subtract the output signal of said first switching means, and the output signal of said second switching means, It is also what consisted of a band-pass filter prepared in the preceding paragraph or the latter part of said operation means, and a frequency-electrical-potential-difference conversion means to generate the electrical potential difference according to the frequency of the output signal of said band-pass filter, and made the output of said band-pass filter the intermediate frequency signal.

[0011]

[Function] This invention can measure the average-frequency error of the intermediate frequency signal over the FSK modulating signal which the modulation required by the bit synchronization signal, and can control a local oscillation frequency by the above-mentioned configuration by this.

[0012] Moreover, since it enables it to start frequency amendment actuation when the FSK modulating signal which the modulation required by the bit synchronization signal more than a certain level inputs, it can introduce easily [an intermittent receiving actuating system].

[0013]

[Example] The example of this invention is explained with reference to drawing 1 below. The first low-pass cutoff filter for a RF magnification means and 3 to intercept the first mixing means, and for an antenna and 2 intercept a dc component in 1, as for 4, In 5, the first switching means and 6 the first local oscillation means and 7 about 90 degrees A phase shifter, The second low-pass cutoff filter for 8 to intercept the second mixing means and for 9 intercept a dc component, 10 90-degree phase shift means and 12 for the second local oscillation means and 11 The second switching means, an operation means by which 13 subtracts and adds, and 14 -- for a frequency-electrical-potential-difference conversion means and 17, as for a pulse number measurement means and 19, a level detection means and 18 are [the third band-pass filter and 15 / a pulse-shape plastic surgery means and 16 / a frequency amendment means and 20] recovery output terminals. The first and second low-pass cutoff

filters 4 and 9 use the band-pass filter in order to serve as the purpose which removes an adjacent channel. The FSK receiving set shown by drawing 1 is a receiving set of a direct conversion method.

[0014] Now, what carried out the FSK modulation of the subcarrier of a 400MHz band by 2400bps data as a FSK modulating signal is considered. If the above-mentioned FSK modulating signal inputs into an antenna 1, a mixing down will be carried out with the signal which was amplified with the RF magnification means 2 and oscillated with the first local oscillation means with the first mixing means 3 and the second mixing means 8. The oscillation frequency of the first local oscillation means is set as the frequency almost equal to the carrier frequency of the FSK modulating signal inputted into an antenna 1. The I signal which is a low frequency signal outputs from the first mixing means 3, and the Q signal which is a low frequency signal outputs from the second mixing means 8. The I signal and the Q signal lie at right angles, at least that of an I signal and a Q signal became the progress and delay information on a phase, and the frequency modulation information on the FSK modulating signal has appeared. The mixing rise of this I signal and Q signal is carried out using the first switching means 5 and second switching means 12 with the oscillation signal of the second local oscillation means 10. And at least that of an I signal and a Q signal is taken out by adding or subtracting with the operation means 13 as an intermediate frequency signal with which the frequency modulation of the progress and the delay information on a phase was carried out again. The oscillation frequency in the second local oscillation means is 16kHz, therefore the intermediate frequency signal from the operation means 13 is set to about 16kHz. An active jamming signal is removed by the third band-pass filter 14, and the intermediate frequency signal which is a signal of choice is taken out. When it is more than level with the output of the third band-pass filter 14, from the level detection means 17, an output arises and the pulse number measurement means 18 is started. between fixed time amount which defined beforehand the pulse number outputted from a pulse-shape plastic surgery means when the pulse number measurement means 18 was started (for example, for [10] m seconds) -- measurement -- it carries out. The pulse-shape plastic surgery means amplified the output of the third band-pass filter, and has changed it into pulse shape using a comparator. With the frequency-electrical-potential-difference conversion means 16, the FSK recovery is performed by changing frequency change of an input into electrical-potential-difference change. The signal by which the FSK recovery was carried out is outputted to an output terminal 20. The pulse number

measured with the pulse number measurement means 18 is inputted into the frequency amendment means 19. With the frequency amendment means 19, the error of the number of reference pulses defined beforehand and the pulse number measured with the pulse number measurement means 18 is calculated, and the control voltage corresponding to an error is generated. The oscillation frequency of the first local oscillation means 6 is controlled by said control voltage, and the average frequency of the intermediate frequency signal which is the output of the third band-pass filter 14 is set to about 16kHz. It says and exceeds about the above frequency amendment actuation, and explains in detail. The case where 3kHz of oscillation frequencies of the first local oscillation means 6 has shifted from the carrier frequency of the FSK modulating signal inputted into an antenna 1 is considered. Then, 3kHz of center frequency of the intermediate frequency signal which is the output of the third band-pass filter 14 shifts from 16kHz, and it is set to 19kHz. With the pulse number measurement means 18, for [10] m seconds, since a 19kHz intermediate frequency signal pulse is measured, and 190 pulses will be counted, 160 pulses are memorized as a reference pulse and 30 is outputted to the frequency amendment means 19 as a pulse number error. The direct current voltage corresponding to 30 is generated by D/A conversion, and the first local oscillation means is controlled by the frequency amendment means 19 so that the center frequency of an intermediate frequency signal is set to about 16kHz. As for the FSK receiving set of drawing 1 , a power source is intermittently turned on only for about [20m second] short time amount at intervals of a certain fixed spacing, for example, 30 seconds. And when an output does not arise from the level detection means 17 while the power source is turned on, a power source is turned off till the following 30 seconds as what does not have a signal from a communications partner. If an output arises from the level detection means 17, ON of a power source will be held and a pulse number will be measured with the pulse number measurement means 18. This is the technique for carrying out long duration actuation of the FSK receiving set by cell drive. The synchronization of the transceiver timing in every 30 seconds with a communications partner can surely be transmitted from one side every 10 minutes, and can be taken by another side's receiving the electric wave and introducing a clock to a transmitting partner. Therefore, level detection can be performed in the part which the modulation required by the bit synchronization signal among the FSK modulating signals from a communications partner, and a pulse number can be measured. The pulse number measurement means 18 can consist of easily timers for controlling

initiation and termination of actuation of a counter and a counter. A timer is 10 m second timer which starts actuation by the signal from the level detection means 17, for example, ends actuation after [of ten] m seconds. Moreover, the frequency amendment means 19 can consist of easily microcomputers which have a storage means to memorize the number of reference pulses, and a D/A conversion means.

[0015] Other examples of this invention are shown in drawing 2 , and it explains to it. The same number is given about what shows the same function as drawing 1 in drawing 2 . The difference in the example of this invention shown in the example and drawing 2 of this invention shown in drawing 1 is in the point of having established a time amount measurement means 21 to measure time amount until the pulse number of the intermediate frequency signal changed into pulse shape with the pulse-shape plastic surgery means 15 instead of the pulse number measurement means 18 of drawing 1 in the example of drawing 2 reaches a certain value defined beforehand. If what the FSK modulating signal inputted into the antenna 1 is detected, the level detection means 17 will output a signal. The time amount measurement means 21 is started by this signal. The time amount measurement means 21 measures time amount after being started until an intermediate frequency signal pulse amounts to 160. If the center frequency of an intermediate frequency signal is 16kHz, the time amount measured with the time amount measurement means 21 is 10 m seconds. If the center frequency of an intermediate frequency signal is 19kHz, the time amount measured with the time amount measurement means 21 will become 8.42 m seconds. The hour entry measured with the time amount measurement means 21 is inputted into the frequency amendment means 19. With the frequency amendment means 19, 10 m seconds are memorized as the conventional time, and a time error with said inputted hour entry is calculated. If the inputted hour entry is 10 m seconds, a time error will be 0 and amendment actuation of a frequency will not be performed. If the inputted hour entry is 8.42 m seconds, a time error will be 1.58 m seconds, and will output the control voltage corresponding to 1.58. And the oscillation frequency of the first local oscillation means is controlled so that an intermediate frequency signal is set to about 16kHz with the control voltage from the frequency amendment means 19. The time amount measurement means 21 can consist of easily a counter which will generate a carry if the pulse from the pulse-shape plastic surgery means 15 is counted to 160, and a timer which will end time amount measurement if a carry occurs from said counter. And initial starting of said counter and timer is performed by the signal from the level detection means 17. The advantage of the

example shown in drawing 2 is to amend a frequency more correctly as raise the accuracy of measurement of the center frequency of an intermediate frequency signal, if precision of the timer which constitutes the time amount measurement means 21 is improved.

[0016] Next, other examples of this invention are shown and explained to drawing 3 . The same number is given about what shows the same function as drawing 1 in drawing 3 . The difference in the example of this invention shown in the example and drawing 1 of this invention shown in drawing 3 takes out the voltage output corresponding to an intermediate frequency with the frequency-electrical-potential-difference conversion means 16 in the example of drawing 3 instead of the pulse number measurement means 18 of drawing 1 , and is in the point of having established an average voltage-output means 22 to have equalized this voltage output during a certain period, and to output the equalized average electrical potential difference. If what the FSK modulating signal inputted into the antenna 1 is detected, the level detection means 17 will output a signal. The average voltage-output means 22 is started by this signal. The average voltage-output means 22 equalizes the electrical potential difference by 10 m seconds, after being started. The frequency-electrical-potential-difference conversion means 16 outputs the electrical potential difference proportional to an input frequency. For example, when the intermediate frequency which is an input frequency is 16kHz, whenever 1kHz of frequencies changes by 1 volt, a 0.1-volt output changes. Therefore, when an intermediate frequency is 19kHz, it becomes the output of 1.3 volts. The electrical-potential-difference information equalized with the average voltage-output means 22 is inputted into the frequency amendment means 19. With the frequency amendment means 19, 1 volt is memorized as reference voltage and an error with said inputted electrical-potential-difference information is calculated. If the inputted electrical-potential-difference information is 1 volt, an error will be 0 and amendment actuation of a frequency will not be performed. If the inputted electrical-potential-difference information is 1.3 volts, an error will be 0.3 volts and will output the control voltage corresponding to 0.3. And the oscillation frequency of the first local oscillation means is controlled so that an intermediate frequency signal is set to about 16kHz with the control voltage from the frequency amendment means 19. Even if the output voltage of the frequency-electrical-potential-difference conversion means 16 has the the same frequency to input, it can consider changing every moment under the effect of temperature etc. Then, it is sometimes necessary to change the reference voltage memorized for the frequency amendment means 19.

There is an approach shown below as the approach. When there is no signal inputted into an antenna 1, an intermediate frequency signal is only a noise signal. Therefore, the center frequency of the noise signal is 16kHz which is the center frequency of the third band-pass filter 14. Furthermore, switching is performed using the second local oscillation frequency of 16kHz by the first switching means 5 and second switching means 12. Although said the first switching means 5 and second switching means 12 have balance mold switch composition which the local oscillation frequency of 16kHz does not produce in an output, a 16kHz signal leaks them to an output a little by dispersion in the transistor which constitutes the above-mentioned balance mold switch etc. Therefore, when a signal does not input into an antenna 1, the center frequency of an intermediate frequency signal is about 16kHz. Therefore, when the signal inputted into an antenna 1 with the level detection means 17 is not detected, the output signal of the frequency-electrical-potential-difference conversion means 16 between a certain periods (for example, for [10] m seconds) is incorporated for the average voltage-output means 22, and the equalized electrical potential difference is memorized for the storage means of the frequency amendment means 19. This storage actuation is performed every 10 minutes which are an integral multiple in every 30 seconds. Moreover, in order to make a 16kHz signal leak positively, the balance of a switch can be lost and the second local oscillation signal can also be made to leak by changing the bias of the first switching means 5 and the second switching means 12.

[0017] Drawing 4 shows an example of the configuration of the frequency-electrical-potential-difference conversion means 16. For the input terminal into which the signal from the pulse-shape plastic surgery means 15 inputs 23 in drawing 4 , and 24, as for a monostable multivibrator and 26, an edge detection means and 25 are [a low pass filter and 20] output terminals. The signal waveform diagram of each terminal of drawing 4 is shown in drawing 5 . For a, in drawing 5 , the signal wave form of a terminal 23 and b are [the output wave of a monostable multivibrator 25 and d of the output wave of the edge detection means 24 and c] the output waves of a low pass filter 26. As for the intermediate frequency signal pulse (a of drawing 5) inputted into the input terminal 23, the rising edge of a pulse is detected by the edge detection means 24. A monostable multivibrator 25 is started by this detected rising edge (b of drawing 5), and the pulse (c of drawing 5) of pulse width regularity outputs to the output of a monostable multivibrator 25. Therefore, the signal to which it restored for the output of a low pass filter 26 outputs (d of drawing 5). The output (c

of drawing 5) of a monostable multivibrator 25 is the pulse signal with same intermediate frequency signal pulse (a of drawing 5) and frequency which are the output of the pulse-shaping means 15. Therefore, it can consider that even a monostable multivibrator 25 is the pulse-shape plastic surgery means 15, and the output signal of a monostable multivibrator 25 can be considered as the input of the pulse number measurement means 18 of drawing 1 , or the time amount measurement means 21 of drawing 2 . Moreover, although explained as what detects only a rising edge as an edge detection means 24, you may make it detect both a standup and falling. In this case, the output of a monostable multivibrator 25 becomes twice an intermediate frequency signal. Therefore, when considering that even a monostable multivibrator 25 is the pulse-shape plastic surgery means 15, it is necessary to change constants, such as the number of reference pulses of the pulse number measurement means 18, the time amount measurement means 21, and the frequency amendment means 19, and a pulse number to take in, in consideration of the frequency having doubled.

[0018]

[Effect of the Invention] The local oscillation means for generating an intermediate frequency signal according to the FSK receiving set of this invention, as explained above, A pulse-shape plastic surgery means to change an intermediate frequency signal into pulse shape, and a pulse number measurement means to measure between a certain time amount which defined beforehand the pulse number from said pulse-shape plastic surgery means, Since it consists of frequency amendment means to output the signal which amends the oscillation frequency of said local oscillation means in the direction which sets to 0 a difference with the number of reference pulses beforehand determined as the measurement result in said pulse number measurement means, A frequency error can be discriminated with a sufficient precision from an easy timer and an easy counter with a microcomputer, and a local oscillation frequency can be amended.

[0019] Moreover, a frequency error can be further identified with a sufficient precision by measuring time amount until it becomes the value which has the pulse number of an intermediate frequency signal with the time amount measurement means 21 instead of measuring the pulse number of fixed time amount which is the pulse number measurement means 18.

[0020] Moreover, it is effective in the ability to reduce the consumed electric current, since it is not necessary to put a power source into the excessive time amount for frequency amendment, and a circuit when not detecting an input signal, since it can constitute so that frequency

error detection and frequency amendment may be performed only when an input signal is detected in the receiving set which performs intermittent reception by having established the level detection means 17.

[0021] Moreover, the first mixing means which takes out the signal used as the frequency of the difference of the signal from the first local oscillation means and said first local oscillation means, and the FSK modulating signal, The second mixing means which takes out the signal used as the frequency of the difference of the signal which carried out the phase shift of the signal from said first local oscillation means, and the FSK modulating signal, The first low-pass cutoff filter which considers the signal from said first mixing means as an input, The second low-pass cutoff filter which considers the signal from said second mixing means as an input, Second local oscillation means to generate the square wave signal which continued in time, and the first switching means which switches the signal from said first low-pass cutoff filter with the square wave signal from said second local oscillation means, The second switching means which switches the signal from said second low-pass cutoff filter with the square wave signal which carried out the phase shift of the square wave signal from said second local oscillation means, An operation means to add or subtract the output signal of said first switching means, and the output signal of said second switching means, The band-pass filter prepared in the preceding paragraph or the latter part of said operation means, Since an intermediate frequency signal can be set as a low frequency by the configuration which consists of frequency-electrical-potential-difference conversion means to generate the electrical potential difference according to the frequency of the output signal of said band-pass filter, and makes the output of a band-pass filter an intermediate frequency signal, Processing speed of the pulse number measurement means 18 or the time amount measurement means 21 can be made late, this does not come out of circuitry as much as possible simply, and it is effective in the ability to reduce the consumed electric current.

[0022] When incorporating the transmitter-receiver of wireless in a gas meter in automatic meter reading systems, such as a gas meter, especially, the receiving set in which the actuation during ten years by cell drive is possible small is required. And since it is installed in the outdoors, temperature conditions have the technical problem that it is severe and fluctuation of the frequency of the crystal oscillator which specifies a local oscillation frequency is large. Therefore, a direct conversion receiving method is used for a miniaturization, and an

intermittent-control-action method is used for consumed-electric-current reduction, and since it corresponds to the frequency drift of a crystal oscillator, it is necessary to perform frequency amendment. Moreover, in the wireless-type remote control unit which makes the start the remote control unit which connects a kitchen not only with an automatic meter reading system but with a gas hot-water supply machine on radio, and uses it for an housing equipment system, small and a cell drive are indispensable conditions. This invention can fill three above-mentioned demands, and can offer the very effective FSK receiving set.
[0023] Moreover, according to the configuration which detects a frequency error using the output of the frequency-electrical-potential-difference conversion means 16, circuitry can be simplified further.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block diagram of the FSK receiving set in one example of this invention
[Drawing 2] The block diagram of the FSK receiving set in other examples of this invention
[Drawing 3] The block diagram of the FSK receiving set in the example of others [pan / this invention]
[Drawing 4] The frequency-electrical-potential-difference conversion means block diagram in the example of this invention
[Drawing 5] The signal waveform diagram of each part of the frequency-electrical-potential-difference conversion means in drawing 4
[Description of Notations]
1 Antenna
2 RF Magnification Means

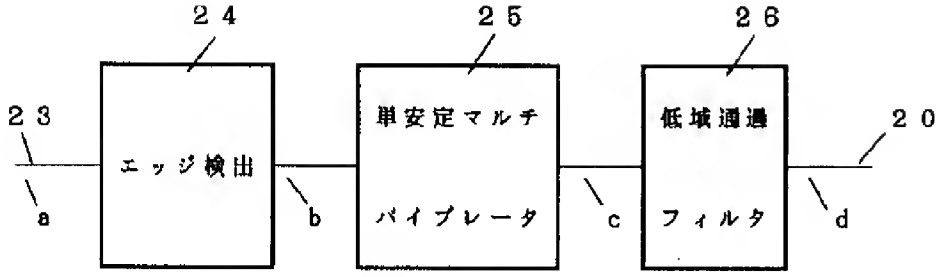
3 First Mixing Means
4 First Band-pass Filter
5 First Switching Means
6 First Local Oscillation Means
7 At Least 90 ″ is Phase Shifter.
8 Second Mixing Means
9 Second Band-pass Filter
10 Second Local Oscillation Means
11 At Least 90 ″ is Phase Means.
12 Second Switching Means
13 Operation Means
14 Third Band-pass Filter
15 Pulse-Shape Plastic Surgery Means
16 Frequency-Electrical-Potential-Difference Conversion Means
17 Level Detection Means
18 Pulse Number Measurement Means
19 Frequency Amendment Means
20 Output Terminal
21 Time Amount Measurement Means

[Translation done.]

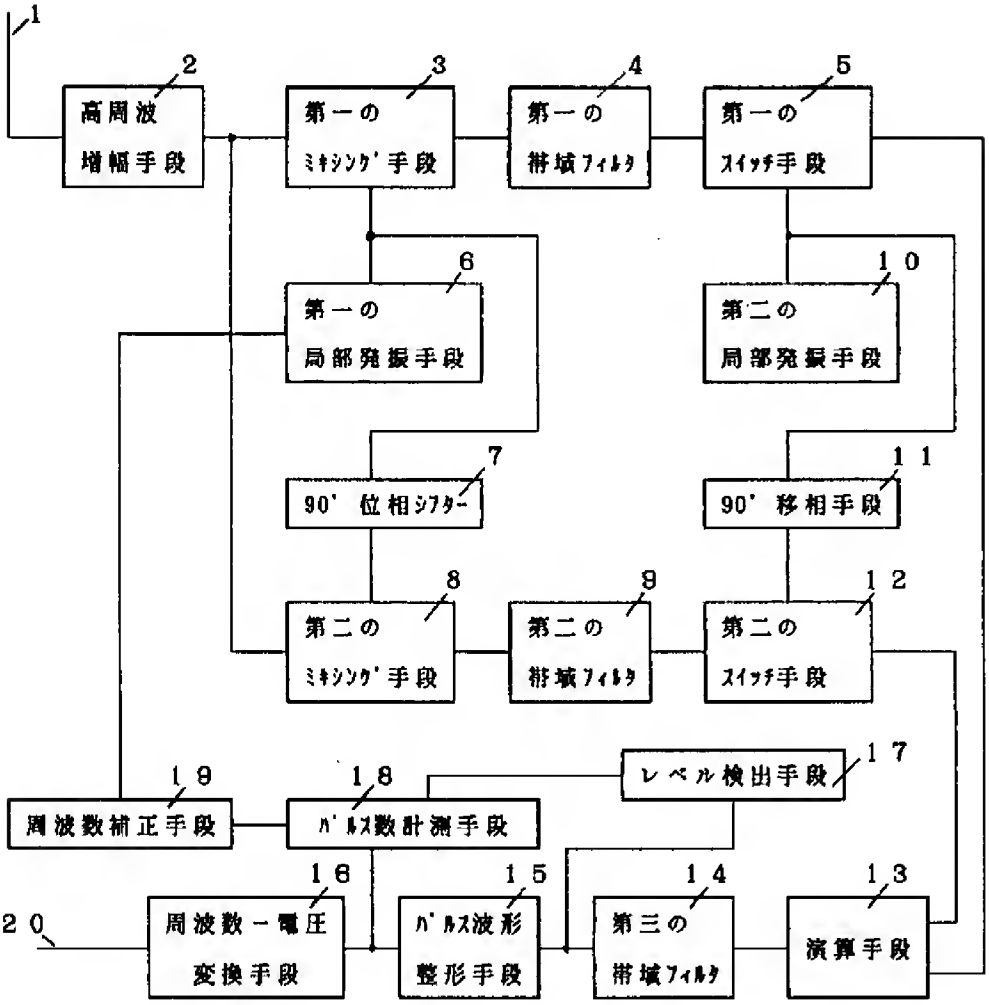
* NOTICES *

DRAWINGS

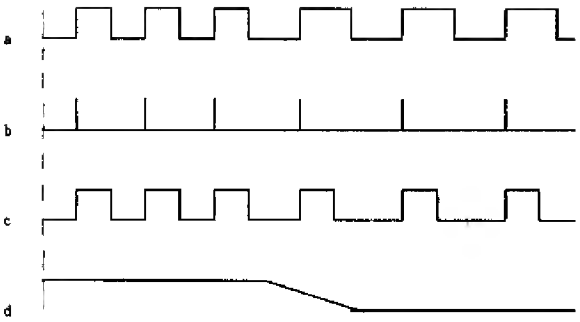
[Drawing 4]



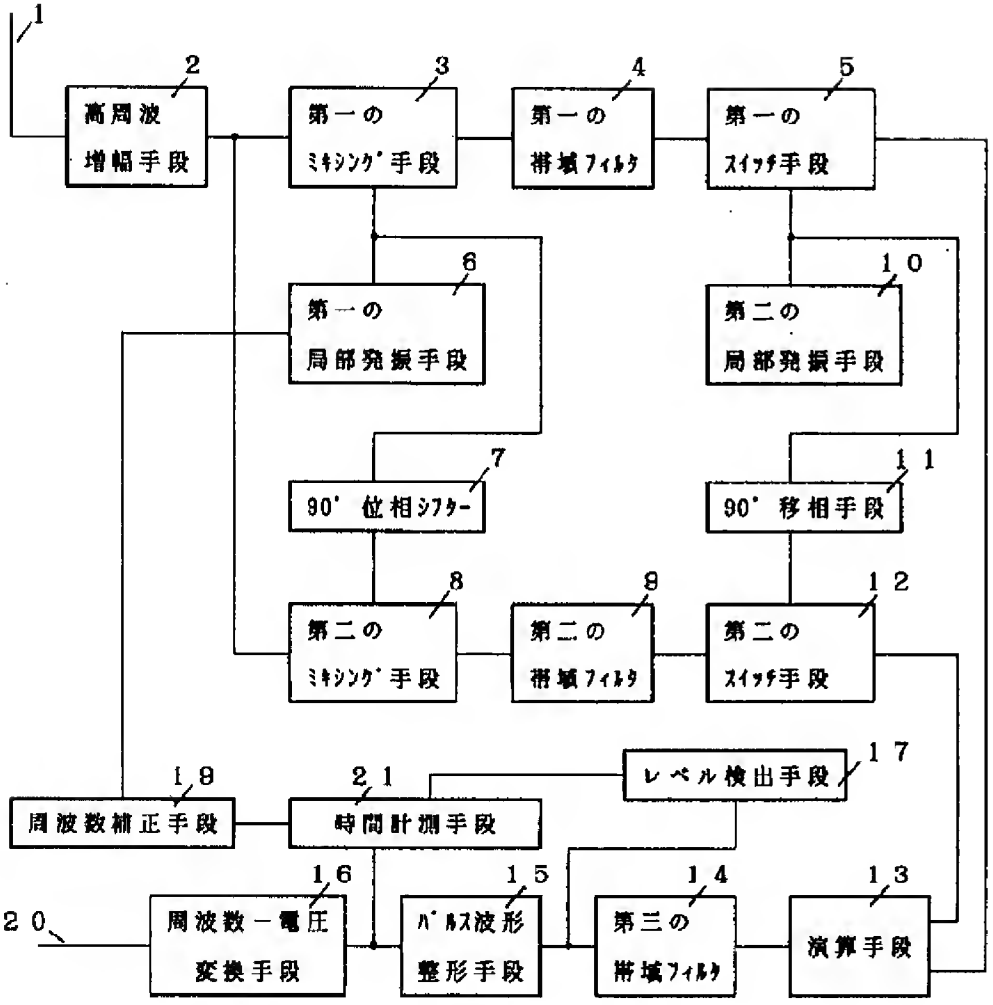
[Drawing 1]



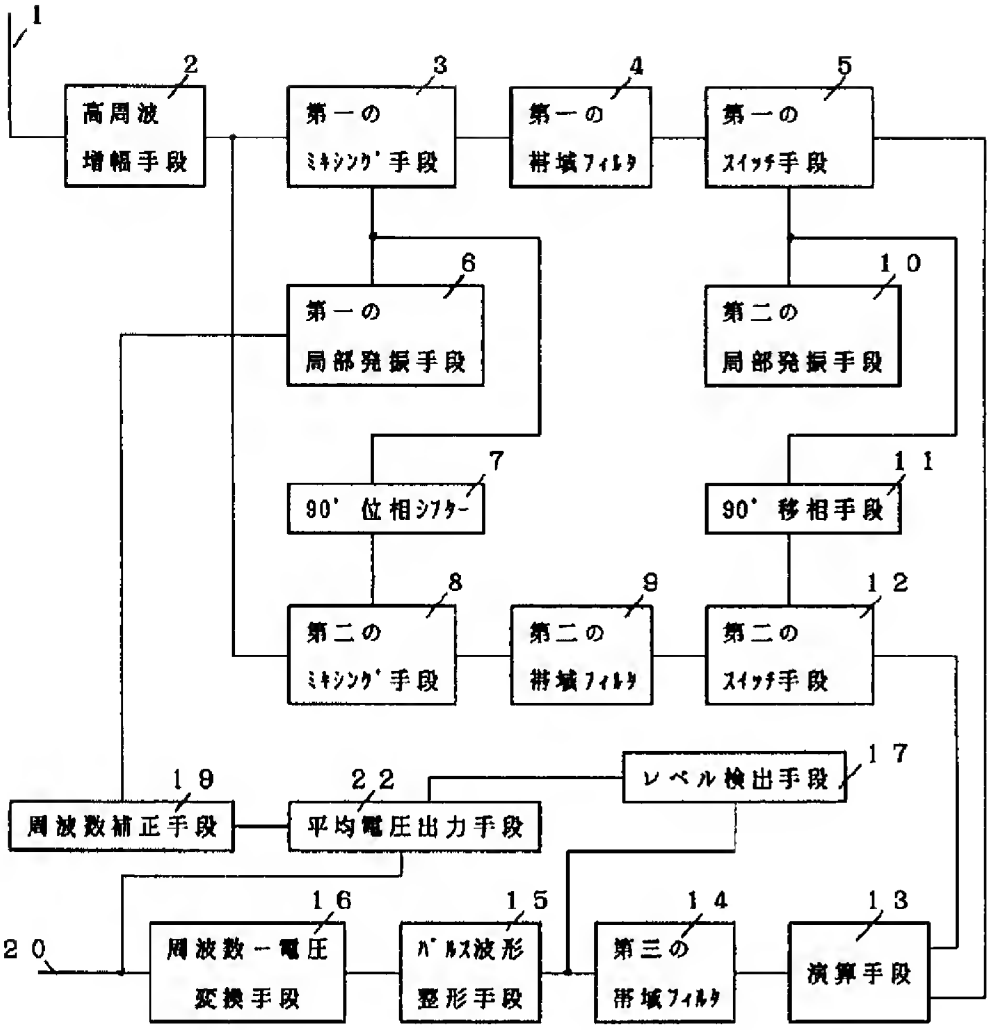
[Drawing 5]



[Drawing 2]



[Drawing 3]



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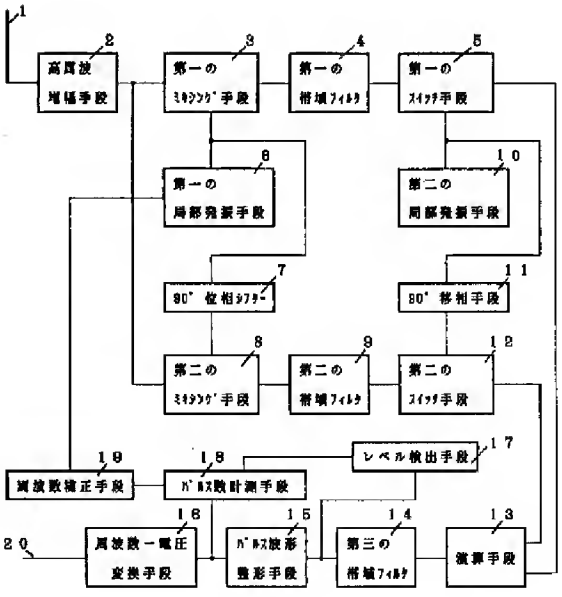
最終頁に続く

(54)【発明の名称】　ＦＳＫ受信装置

(57)【要約】

【目的】　中間周波信号が受信帯域フィルタの中心にくるよう局部発振周波数を制御する。

【構成】　局部発振信号を出力する局部発振手段６と、局部発振信号６とＦＳＫ変調信号とをミキシングして中間周波信号を出力する第一のミキシング手段３および第二のミキシング手段８と、中間周波信号をパルス波形に変換するパルス波形整形手段１５と、パルス波形整形手段１５からのパルス数をあらかじめ定めたある時間の間計測するパルス数計測手段１８と、パルス数計測手段１８での計測結果とあらかじめ定めた基準パルス数との差を０とする方向に局部発振手段６の発振周波数を補正する信号を出力する周波数補正手段１９とで構成している。



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【特許請求の範囲】

【請求項１】１と０のくりかえしからなり情報に先だって伝送されるビット同期信号を含む信号で周波数変調されたＦＳＫ変調信号を中間周波信号に変換した後復調するＦＳＫ受信装置であって、局部発振信号を出力する局部発振手段と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信号をパルス波形に変換するパルス波形整形手段と、前記パルス波形整形手段からのパルス数をあらかじめ定めたある時間の間計測するパルス数計測手段と、前記パルス数計測手段での計測結果とあらかじめ定めた基準パルス数との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とで構成されたＦＳＫ受信装置。

【請求項２】１と０のくりかえしからなり情報に先だって伝送されるビット同期信号を含む信号で周波数変調されたＦＳＫ変調信号を中間周波信号に変換した後復調するＦＳＫ受信装置であって、局部発振信号を出力する局部発振手段と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信号をパルス波形に変換するパルス波形整形手段と、前記パルス波形整形手段からのパルス数があらかじめ定めた数に達するまでの時間を計測する時間計測手段と、前記時間計測手段での計測結果とあらかじめ定めた基準時間との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とで構成されたＦＳＫ受信装置。

【請求項３】１と０のくりかえしからなり情報に先だって伝送されるビット同期信号を含む信号で周波数変調されたＦＳＫ変調信号を中間周波信号に変換した後復調するＦＳＫ受信装置であって、前記ＦＳＫ変調信号の受信レベルがあるレベル以上であるかどうかを検出するレベル検出手段と、局部発振信号を出力する局部発振手段と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信号をパルス波形に変換するパルス波形整形手段と、前記レベル検出手段によりＦＳＫ変調信号の受信レベルがあるレベル以上であると判定された時に前記パルス波形整形手段からのパルス数をあらかじめ定めたある時間の間計測するパルス数計測手段と、前記パルス数計測手段での計測結果とあらかじめ定めた基準パルス数との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とで構成されたＦＳＫ受信装置。

【請求項４】１と０のくりかえしからなり情報に先だって伝送されるビット同期信号を含む信号で周波数変調されたＦＳＫ変調信号を中間周波信号に変換した後復調するＦＳＫ受信装置であって、前記ＦＳＫ変調信号の受信レベルがあるレベル以上であるかどうかを検出するレベル検出手段と、局部発振信号を出力する局部発振手段

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と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信号をパルス波形に変換するパルス波形整形手段と、前記レベル検出手段によりＦＳＫ変調信号の受信レベルがあるレベル以上であると判定された時に前記パルス波形整形手段からのパルス数があらかじめ定めた数に達するまでの時間を計測する時間計測手段と、前記時間計測手段での計測結果とあらかじめ定めた基準時間との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とで構成されたＦＳＫ受信装置。

【請求項５】１と０のくりかえしからなり情報に先だって伝送されるビット同期信号を含む信号で周波数変調されたＦＳＫ変調信号を中間周波信号に変換した後復調するＦＳＫ受信装置であって、前記ＦＳＫ変調信号の受信レベルがあるレベル以上であるかどうかを検出するレベル検出手段と、局部発振信号を出力する局部発振手段と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信号をの周波数に応じた電圧を出力する周波数－電圧変換手段と、前記レベル検出手段によりＦＳＫ変調信号の受信レベルがあるレベル以上であると判定された時に前記周波数－電圧変換手段からの出力電圧のある期間の平均電圧を出力する平均電圧出力手段と、平均電圧出力手段からの電圧とあらかじめ定めた基準電圧との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とで構成されたＦＳＫ受信装置。

【請求項６】ＦＳＫ受信装置は、第一の局部発振手段と、前記第一の局部発振手段からの信号とＦＳＫ変調信号の差の周波数となる信号を取り出す第一のミキシング手段と、前記第一の局部発振手段からの信号を位相シフトした信号とＦＳＫ変調信号の差の周波数となる信号を取り出す第二のミキシング手段と、前記第一のミキシング手段からの信号を入力とする第一の低域遮断フィルタと、前記第二のミキシング手段からの信号を入力とする第二の低域遮断フィルタと、時間的に連続した矩形波信号を発生する第二の局部発振手段と、前記第二の局部発振手段からの矩形波信号により前記第一の低域遮断フィルタからの信号をスイッチする第一のスイッチ手段と、前記第二の局部発振手段からの矩形波信号を位相シフトした矩形波信号により前記第二の低域遮断フィルタからの信号をスイッチする第二のスイッチ手段と、前記第一のスイッチ手段の出力信号と前記第二のスイッチ手段の出力信号とを加算または引算する演算手段と、前記演算手段の前段あるいは後段に設けられた帯域通過フィルタと、前記帯域通過フィルタの出力信号の周波数に応じた電圧を発生する周波数－電圧変換手段とで構成され、前記帯域通過フィルタの出力を中間周波信号とした請求項１、２、３、４または５記載のＦＳＫ受信装置。

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【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、主としてダイレクトコンバージョン方式のＦＳＫ受信装置に関するものである。

【０００２】

【従来の技術】一般に無線通信におけるＦＳＫ受信方式として受信したＦＳＫ変調信号を中間周波信号に変換した後復調するシングルスーパヘテロダイン方式やダブルスーパヘテロダイン方式が用いられている。またイメージ周波数を除去するための帯域フィルタや隣接チャンネル信号を除去するための帯域フィルタをＩＣで構成可能な受信方式としてダイレクトコンバージョン方式がある。ダイレクトコンバージョン方式の一例として、受信信号の中心周波数にほぼ等しい周波数を有する直交する２つの局部発振信号と受信信号をそれぞれミキシングすることにより直交する２つのベースバンド信号に受信信号を変換しフィルタで希望信号のみを取りだした後、数十ｋＨｚの中間周波数に変換して復調する方式がある。いずれの受信方式においても局部発振手段の発振周波数安定度が悪いと受信特性が悪化するため中間周波信号が帯域フィルタの中心に来るように局部発振手段の発振周波数を制御するように構成したＦＳＫ受信装置がある。このような局部発振周波数を制御する従来のＦＳＫ受信装置の例として、特願昭５８－２３０８０７号の「受信装置」に示されているように受信した基準周波数を周波数分析し、周波数分析の結果に基づき局部発振手段を制御する構成のものがある。また別の例としては、特公昭５５－３７１３１号公報の「ＦＳＫ受信装置用ＡＦＣ方式」に示されているように情報符号に先だって送られる前置信号を利用し周波数弁別回路（＝周波数－電圧変換手段）の出力を用いてＡＦＣ閉ループを構成し局部発振手段の発振周波数を制御し、前置信号の受信を完了した時に前記ＡＦＣ閉ループの制御電圧を記憶し、前記記憶した制御電圧を開ループにより局部発振手段に印加する構成のものがある。

【０００３】

【発明が解決しようとする課題】しかしながら上記従来のＦＳＫ受信装置では、周波数分析手段としてフーリエ変換手法を用いた方法やフィルタを複数個ならべた方法を用いており高速処理のディジタルシグナルプロセッサや多くのアナログフィルタを必要とし、安価に構成できなかった。また基準周波数あるいは前置信号として単一の周波数信号を必要とするため、１と０のくりかえしからなり情報に先だって伝送されるビット同期信号の前に通常不要な単一の周波数信号を送らなければならず、伝送効率を悪化させるという課題があった。さらに周波数分析手段の動作の開始や局部発振周波数の制御を開始するタイミングについて上記二つの引用例では明確でなく、基準周波数や前置信号の周波数分析動作や受信動作を常に行っている必要があり間欠的なＦＳＫ受信システムに従来の方法を採用できなかった。

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【０００４】本発明は上記課題を解決するもので、簡単な構成でかつビット同期信号の前に不要な付加信号を付けることなく帯域フィルタの中心からの中間周波信号のずれを検出し局部発振周波数を制御することのできるＦＳＫ受信装置を実現することを目的としたものである。

【０００５】

【課題を解決するための手段】上記目的を達成するために、本発明のＦＳＫ受信装置は、１と０のくりかえしからなり情報に先だって伝送されるビット同期信号を含む信号で周波数変調されたＦＳＫ変調信号を中間周波信号に変換した後復調するＦＳＫ受信装置であって、局部発振信号を出力する局部発振手段と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信号をパルス波形に変換するパルス波形整形手段と、前記パルス波形整形手段からのパルス数をあらかじめ定めたある時間の間計測するパルス数計測手段と、前記パルス数計測手段での計測結果とあらかじめ定めた基準パルス数との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とを備えている。

【０００６】また、局部発振信号を出力する局部発振手段と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信号をパルス波形に変換するパルス波形整形手段と、前記パルス波形整形手段からのパルス数があらかじめ定めた数に達するまでの時間を計測する時間計測手段と、前記時間計測手段での計測結果とあらかじめ定めた基準時間との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とを備えたものでもある。

【０００７】さらに、ＦＳＫ変調信号の受信レベルがあるレベル以上であるかどうかを検出するレベル検出手段と、局部発振信号を出力する局部発振手段と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信号をパルス波形に変換するパルス波形整形手段と、前記レベル検出手段によりＦＳＫ変調信号の受信レベルがあるレベル以上であると判定された時に前記パルス波形整形手段からのパルス数をあらかじめ定めたある時間の間計測するパルス数計測手段と、前記パルス数計測手段での計測結果とあらかじめ定めた基準パルス数との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とで構成されている。

【０００８】また、ＦＳＫ変調信号の受信レベルがあるレベル以上であるかどうかを検出するレベル検出手段と、局部発振信号を出力する局部発振手段と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信

号をパルス波形に変換するパルス波形整形手段と、前記レベル検出手段によりＦＳＫ変調信号の受信レベルがあるレベル以上であると判定された時に前記パルス波形整形手段からのパルス数があらかじめ定めた数に達するまでの時間を計測する時間計測手段と、前記時間計測手段での計測結果とあらかじめ定めた基準時間との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とで構成されている。

【０００９】また、ＦＳＫ変調信号の受信レベルがあるレベル以上であるかどうかを検出するレベル検出手段と、局部発振信号を出力する局部発振手段と、前記局部発振信号と前記ＦＳＫ変調信号とをミキシングして中間周波信号を出力するミキシング手段と、前記中間周波信号をの周波数に応じた電圧を出力する周波数－電圧変換手段と、前記レベル検出手段によりＦＳＫ変調信号の受信レベルがあるレベル以上であると判定された時に前記周波数－電圧変換手段からの出力電圧のある期間の平均電圧を出力する平均電圧出力手段と、平均電圧出力手段からの電圧とあらかじめ定めた基準電圧との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とで構成されている。

【００１０】さらに、ＦＳＫ受信装置は、第一の局部発振手段と、前記第一の局部発振手段からの信号とＦＳＫ変調信号の差の周波数となる信号を取り出す第一のミキシング手段と、前記第一の局部発振手段からの信号を位相シフトした信号とＦＳＫ変調信号の差の周波数となる信号を取り出す第二のミキシング手段と、前記第一のミキシング手段からの信号を入力とする第一の低域遮断フィルタと、前記第二のミキシング手段からの信号を入力とする第二の低域遮断フィルタと、時間的に連続した矩形波信号を発生する第二の局部発振手段と、前記第二の局部発振手段からの矩形波信号により前記第一の低域遮断フィルタからの信号をスイッチする第一のスイッチ手段と、前記第二の局部発振手段からの矩形波信号を位相シフトした矩形波信号により前記第二の低域遮断フィルタからの信号をスイッチする第二のスイッチ手段と、前記第一のスイッチ手段の出力信号と前記第二のスイッチ手段の出力信号とを加算または引算する演算手段と、前記演算手段の前段あるいは後段に設けられた帯域通過フィルタと、前記帯域通過フィルタの出力信号の周波数に応じた電圧を発生する周波数－電圧変換手段とで構成され、前記帯域通過フィルタの出力を中間周波信号としたものでもある。

【００１１】

【作用】本発明は上記構成によって、ビット同期信号で変調のかかったＦＳＫ変調信号に対する中間周波信号の平均周波数誤差を計測することができ、これにより局部発振周波数を制御できることとなる。

【００１２】また、あるレベル以上のビット同期信号で変調のかかったＦＳＫ変調信号が入力したときに周波数補正動作を開始できるようにしているため間欠受信動作システムに簡単に導入できることとなる。

【００１３】

【実施例】以下本発明の実施例を図１を参照して説明する。１はアンテナ、２は高周波増幅手段、３は第一のミキシング手段、４は直流成分を遮断するための第一の低域遮断フィルタ、５は第一のスイッチ手段、６は第一の局部発振手段、７は９０°位相シフター、８は第二のミキシング手段、９は直流成分を遮断するための第二の低域遮断フィルタ、１０は第二の局部発振手段、１１は９０°移相手段、１２は第二のスイッチ手段、１３は加減算を行う演算手段、１４は第三の帯域通過フィルタ、１５はパルス波形整形手段、１６は周波数－電圧変換手段、１７はレベル検出手段、１８はパルス数計測手段、１９は周波数補正手段、２０は復調出力端子である。第一及び第二の低域遮断フィルタ４及び９は隣接チャンネルを除去する目的を兼ねるため帯域通過フィルタを用いている。図１で示すＦＳＫ受信装置はダイレクトコンバージョン方式の受信装置である。

【００１４】さてＦＳＫ変調信号として４００ＭＨｚ帯の搬送波を２４００ｂｐｓのデータでＦＳＫ変調したものを考える。上記ＦＳＫ変調信号がアンテナ１に入力すると、高周波増幅手段２で増幅され、第一のミキシング手段３及び第二のミキシング手段８で第一の局部発振手段で発振された信号とミキシングダウンされる。第一の局部発振手段の発振周波数はアンテナ１に入力するＦＳＫ変調信号の搬送波周波数にほぼ等しい周波数に設定されている。第一のミキシング手段３から低周波信号であるＩ信号が出力し、第二のミキシング手段８からは低周波信号であるＱ信号が出力する。Ｉ信号とＱ信号は直交しており、ＦＳＫ変調信号の周波数変調情報がＩ信号とＱ信号の位相の進み・遅れ情報となって現れている。このＩ信号とＱ信号を第二の局部発振手段１０の発振信号により第一のスイッチ手段５及び第二のスイッチ手段１２を用いてミキシングアップする。そして演算手段１３で加算あるいは減算することによりＩ信号とＱ信号の位相の進み・遅れ情報が再び周波数変調された中間周波信号として取り出される。第二の局部発振手段での発振周波数は例えば１６ｋＨｚであり、従って演算手段１３からの中間周波信号はほぼ１６ｋＨｚとなる。第三の帯域通過フィルタ１４で妨害信号が除去され希望信号である中間周波信号が取り出される。第三の帯域通過フィルタ１４の出力があるレベル以上あった場合には、レベル検出手段１７より出力が生じ、パルス数計測手段１８を起動する。パルス数計測手段１８が起動されると、パルス波形整形手段から出力するパルス数をあらかじめ定めた一定時間の間（例えば１０ｍ秒間）計測する。パルス波形整形手段は、第三の帯域通過フィルタの出力を増幅しかつコンパレータを用いてパルス波形に変換している。周波数－電圧変換手段１６では入力の周波数変化を電圧

変化に変換することによりＦＳＫ復調を行っている。ＦＳＫ復調された信号は出力端子２０に出力する。パルス数計測手段１８で計測されたパルス数は周波数補正手段１９に入力する。周波数補正手段１９ではあらかじめ定めた基準パルス数とパルス数計測手段１８で計測されたパルス数の誤差を計算し誤差に対応した制御電圧を発生する。前記制御電圧により第一の局部発振手段６の発振周波数は制御され第三の帯域通過フィルタ１４の出力である中間周波信号の平均周波数がほぼ１６ｋＨｚになる。以上の周波数補正動作についてもうすこしくわしく説明する。第一の局部発振手段６の発振周波数がアンテナ１に入力するＦＳＫ変調信号の搬送波周波数から３ｋＨｚずれている場合を考える。すると第三の帯域通過フィルタ１４の出力である中間周波信号の中心周波数は１６ｋＨｚから３ｋＨｚずれて１９ｋＨｚになる。パルス数計測手段１８では１０ｍ秒間、１９ｋＨｚの中間周波信号パルスを計測するので１９０パルスを数えることになるそして基準パルスとして１６０パルスが記憶されており、パルス数誤差として３０を周波数補正手段１９に出力する。周波数補正手段１９では３０に対応した直流電圧をＤ／Ａ変換により発生し、中間周波信号の中心周波数がほぼ１６ｋＨｚになるよう第一の局部発振手段を制御する。図１のＦＳＫ受信装置はある一定間隔、例えば３０秒間隔で２０ｍ秒程度の短い時間だけ間欠的に電源がＯＮされる。そして電源がＯＮされている間にレベル検出手段１７より出力が生じない場合には通信相手より信号がないものとして次の３０秒まで電源をＯＦＦする。もしレベル検出手段１７より出力が生じれば、電源のＯＮを保持し、パルス数計測手段１８でパルス数の計測をおこなう。これはＦＳＫ受信装置を電池駆動で長時間動作させるための手法である。通信相手との３０秒毎の送受信タイミングの同期は例えば１０分毎に一方から必ず送信を行い、その電波を他方が受信し時計を送信相手にあわせることにより取ることができる。そのため通信相手からのＦＳＫ変調信号のうちビット同期信号で変調のかかった部分でレベル検出を行い、かつパルス数を計測することができる。パルス数計測手段１８はカウンタとカウンタの動作の開始及び終了を制御するためのタイマーで簡単に構成することができる。タイマーはレベル検出手段１７からの信号で動作を開始し、例えば１０ｍ秒後に動作を終了する１０ｍ秒タイマーである。また周波数補正手段１９は基準パルス数を記憶しておく記憶手段とＤ／Ａ変換手段とを有するマイクロコンピュータで簡単に構成できる。

【００１５】図２に本発明の他の実施例を示し説明する。図２において図１と同じ機能を示すものについては同一番号を付与している。図１に示す本発明の実施例と図２に示す本発明の実施例の違いは、図２の実施例においては図１のパルス数計測手段１８の代わりにパルス波形整形手段１５でパルス波形に変換された中間周波信号

のパルス数があらかじめ定めたある値に達するまでの時間を計測する時間計測手段２１を設けた点にある。アンテナ１にＦＳＫ変調信号が入力したことを検知すると、レベル検出手段１７は信号を出力する。この信号により時間計測手段２１は起動される。時間計測手段２１は、起動されてから例えば中間周波信号パルスが１６０に達するまでの時間を計測する。もし中間周波信号の中心周波数が１６ｋＨｚであれば、時間計測手段２１で計測される時間は１０ｍ秒である。中間周波信号の中心周波数が１９ｋＨｚであれば、時間計測手段２１で計測される時間は８．４２ｍ秒となる。時間計測手段２１で計測された時間情報は周波数補正手段１９に入力する。周波数補正手段１９では基準時間として１０ｍ秒を記憶しており、前記入力した時間情報との時間誤差を計算する。入力した時間情報が１０ｍ秒であれば時間誤差は０であり、周波数の補正動作は行わない。入力した時間情報が８．４２ｍ秒であれば、時間誤差は１．５８ｍ秒であり、１．５８に対応した制御電圧を出力する。そして周波数補正手段１９からの制御電圧により中間周波信号がほぼ１６ｋＨｚになるよう第一の局部発振手段の発振周波数が制御される。時間計測手段２１は、パルス波形整形手段１５からのパルスを１６０までかぞえたらキャリーを発生するカウンターと、前記カウンターからキャリーが発生したら時間計測を終了するタイマーとで簡単に構成することができる。そして前記カウンターとタイマーの初期起動はレベル検出手段１７からの信号で行われる。図２に示す実施例の利点は、時間計測手段２１を構成するタイマーの精度を良くすれば中間周波信号の中心周波数の測定精度を向上させることができよって周波数の補正をより正確に行うことにある。

【００１６】次に本発明の他の実施例を図３に示し説明する。図３において図１と同じ機能を示すものについては同一番号を付与している。図３に示す本発明の実施例と図１に示す本発明の実施例の違いは、図３の実施例においては図１のパルス数計測手段１８の代わりに周波数－電圧変換手段１６で中間周波数に対応した電圧出力を取り出し、この電圧出力をある期間の間平均化し、平均化された平均電圧を出力する平均電圧出力手段２２を設けた点にある。アンテナ１にＦＳＫ変調信号が入力したことを検知すると、レベル検出手段１７は信号を出力する。この信号により平均電圧出力手段２２は起動される。平均電圧出力手段２２は、起動されてから例えば１０ｍ秒までの電圧を平均化する。周波数－電圧変換手段１６は、入力周波数に比例した電圧を出力する。例えば入力周波数である中間周波数が１６ｋＨｚの時１ボルトで周波数が１ｋＨｚ変化する毎に０．１ボルト出力が変化する。従って、中間周波数が１９ｋＨｚの時１．３ボルトの出力となる。平均電圧出力手段２２で平均化された電圧情報は周波数補正手段１９に入力する。周波数補正手段１９では基準電圧として１ボルトを記憶してお

り、前記入力した電圧情報との誤差を計算する。入力した電圧情報が１ボルトであれば誤差は０であり、周波数の補正動作は行わない。入力した電圧情報が１．３ボルトであれば、誤差は０．３ボルトであり、０．３に対応した制御電圧を出力する。そして周波数補正手段１９からの制御電圧により中間周波信号がほぼ１６ｋＨｚになるよう第一の局部発振手段の発振周波数が制御される。周波数－電圧変換手段１６の出力電圧は、入力する周波数が同じであっても温度等の影響で刻々変化することが考えられる。そこで周波数補正手段１９に記憶している基準電圧を時々変更してやる必要がある。その方法として次に示す方法がある。アンテナ１に入力する信号がない場合、中間周波信号は雑音信号だけである。従ってその雑音信号の中心周波数は第三の帯域通過フィルタ１４の中心周波数である１６ｋＨｚである。さらに、第一のスイッチ手段５及び第二のスイッチ手段１２で第二の局部発振周波数１６ｋＨｚを用いてスイッチ動作を行っている。前記第一のスイッチ手段５及び第二のスイッチ手段１２は局部発振周波数１６ｋＨｚが出力に生じないようなバランス型スイッチ構成となっているが上記バランス型スイッチを構成するトランジスタのばらつき等により１６ｋＨｚ信号が出力に若干リークする。よって、アンテナ１に信号が入力しない場合には、中間周波信号の中心周波数はほぼ１６ｋＨｚとなっている。従って、レベル検出手段１７でアンテナ１に入力する信号を検出しなかった時に、ある期間（例えば１０ｍ秒間）の間周波数－電圧変換手段１６の出力信号を平均電圧出力手段２２に取り込み、平均化された電圧を周波数補正手段１９の記憶手段に記憶する。この記憶動作は例えば３０秒毎の整数倍である１０分毎に行う。また１６ｋＨｚ信号を積極的にリークさせるために第一のスイッチ手段５及び第二のスイッチ手段１２のバイアスを変化させることによりスイッチのバランスをくずし、第二の局部発振信号をリークさせることもできる。

【００１７】図４は周波数－電圧変換手段１６の構成の一例を示したものである。図４において２３はパルス波形整形手段１５からの信号が入力する入力端子、２４はエッジ検出手段、２５は単安定マルチバイブレータ、２６は低域通過フィルタ、２０は出力端子である。図５に図４の各端子の信号波形図を示す。図５においてａは端子２３の信号波形、ｂはエッジ検出手段２４の出力波形、ｃは単安定マルチバイブレータ２５の出力波形、ｄは低域通過フィルタ２６の出力波形である。入力端子２３に入力した中間周波信号パルス（図５のａ）はエッジ検出手段２４でパルスの立ち上がりエッジが検出される。この検出された立ち上がりエッジ（図５のｂ）により単安定マルチバイブレータ２５が起動され、単安定マルチバイブレータ２５の出力にパルス幅一定のパルス（図５のｃ）が出力する。したがって低域通過フィルタ２６の出力には復調された信号が出力（図５のｄ）する。単安定マルチバイブレータ２５の出力（図５のｃ）はパルス整形手段１５の出力である中間周波信号パルス（図５のａ）と周波数が同じパルス信号である。従って、単安定マルチバイブレータ２５までをパルス波形整形手段１５とみなし単安定マルチバイブレータ２５の出力信号を図１のパルス数計測手段１８あるいは図２の時間計測手段２１の入力とすることができる。またエッジ検出手段２４として立ち上がりエッジのみを検出するものとして説明したが、立ち上がり及び立ち下がりの両方を検出するようにしてもよい。この場合、単安定マルチバイブレータ２５の出力は中間周波信号の２倍となる。よって単安定マルチバイブレータ２５までをパルス波形整形手段１５とみなす場合、周波数が２倍になっていることを考慮してパルス数計測手段１８、時間計測手段２１、周波数補正手段１９の基準パルス数やとりこむパルス数等の定数を変更する必要がある。

【００１８】

【発明の効果】以上説明したように本発明のＦＳＫ受信装置によれば、中間周波信号を生成するための局部発振手段と、中間周波信号をパルス波形に変換するパルス波形整形手段と、前記パルス波形整形手段からのパルス数をあらかじめ定めたある時間の間計測するパルス数計測手段と、前記パルス数計測手段での計測結果とあらかじめ定めた基準パルス数との差を０とする方向に前記局部発振手段の発振周波数を補正する信号を出力する周波数補正手段とで構成されているため、簡単なタイマーやカウンタとマイクロコンピュータで周波数誤差を精度よく識別し、局部発振周波数を補正することができる。

【００１９】またパルス数計測手段１８である一定時間のパルス数を計測することの代わりに、時間計測手段２１で中間周波信号のパルス数がある値になるまでの時間を計測することにより、よりいっそう周波数誤差を精度よく識別できる。

【００２０】またレベル検出手段１７を設けたことにより、間欠受信を行う受信装置において受信信号を検出した時のみ周波数誤差検出及び周波数補正を行うように構成できるため、受信信号を検出しない時には周波数補正のための余分な時間、回路に電源をいれておく必要がないため消費電流を低減できるという効果がある。

【００２１】また、第一の局部発振手段と、前記第一の局部発振手段からの信号とＦＳＫ変調信号の差の周波数となる信号を取り出す第一のミキシング手段と、前記第一の局部発振手段からの信号を位相シフトした信号とＦＳＫ変調信号の差の周波数となる信号を取り出す第二のミキシング手段と、前記第一のミキシング手段からの信号を入力とする第一の低域遮断フィルタと、前記第二のミキシング手段からの信号を入力とする第二の低域遮断フィルタと、時間的に連続した矩形波信号を発生する第二の局部発振手段と、前記第二の局部発振手段からの矩形波信号により前記第一の低域遮断フィルタからの信号

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をスイッチする第一のスイッチ手段と、前記第二の局部発振手段からの矩形波信号を位相シフトした矩形波信号により前記第二の低域遮断フィルタからの信号をスイッチする第二のスイッチ手段と、前記第一のスイッチ手段の出力信号と前記第二のスイッチ手段の出力信号とを加算または引算する演算手段と、前記演算手段の前段あるいは後段に設けられた帯域通過フィルタと、前記帯域通過フィルタの出力信号の周波数に応じた電圧を発生する周波数－電圧変換手段とで構成され、帯域通過フィルタの出力を中間周波信号とする構成により、中間周波信号を低い周波数に設定することができるため、パルス数計測手段１８あるいは時間計測手段２１の処理速度を遅くでき、これにより回路構成を簡単にできるだけでなく、消費電流を低減できるという効果がある。

【００２２】特に、ガスメータ等の自動検針システムにおいてガスメータ内に無線の送受信装置を組み込む場合、小型でかつ電池駆動で１０年間動作可能な受信装置が必要である。そして屋外に設置されるため温度条件は過酷であり、局部発振周波数を規定する水晶発振器の周波数の変動が大きいという課題がある。そのため小型化のためにダイレクトコンバージョン受信方式を用い、消費電流低減のために間欠動作方式を用い、水晶発振器の周波数変動に対応するため周波数補正を行う必要がある。また自動検針システムに限らずガス給湯器と台所を無線で接続するリモコン装置を初めとして住宅設備システムに用いる無線式のリモコン装置においては小型かつ電池駆動は必須条件である。本発明は、上記３つの要求を満たすものであり、非常に有効なＦＳＫ受信装置を提供することができる。

【００２３】また周波数－電圧変換手段１６の出力を用いて周波数誤差の検出を行う構成によれば、回路構成をよりいっそう簡略化できる。

【図面の簡単な説明】

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【図１】本発明の一実施例におけるＦＳＫ受信装置のブロック図

【図２】本発明の他の実施例におけるＦＳＫ受信装置のブロック図

【図３】本発明さらに他の実施例におけるＦＳＫ受信装置のブロック図

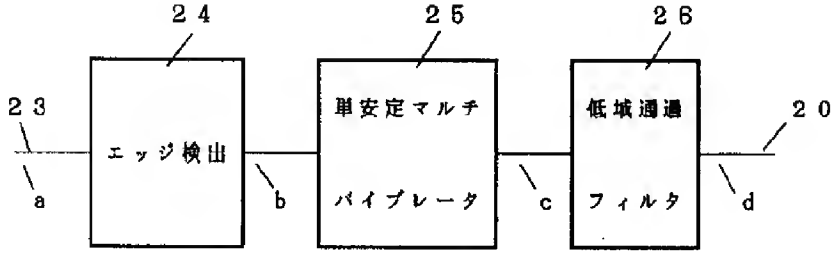
【図４】本発明の実施例における周波数－電圧変換手段ブロック図

【図５】図４における周波数－電圧変換手段の各部の信号波形図

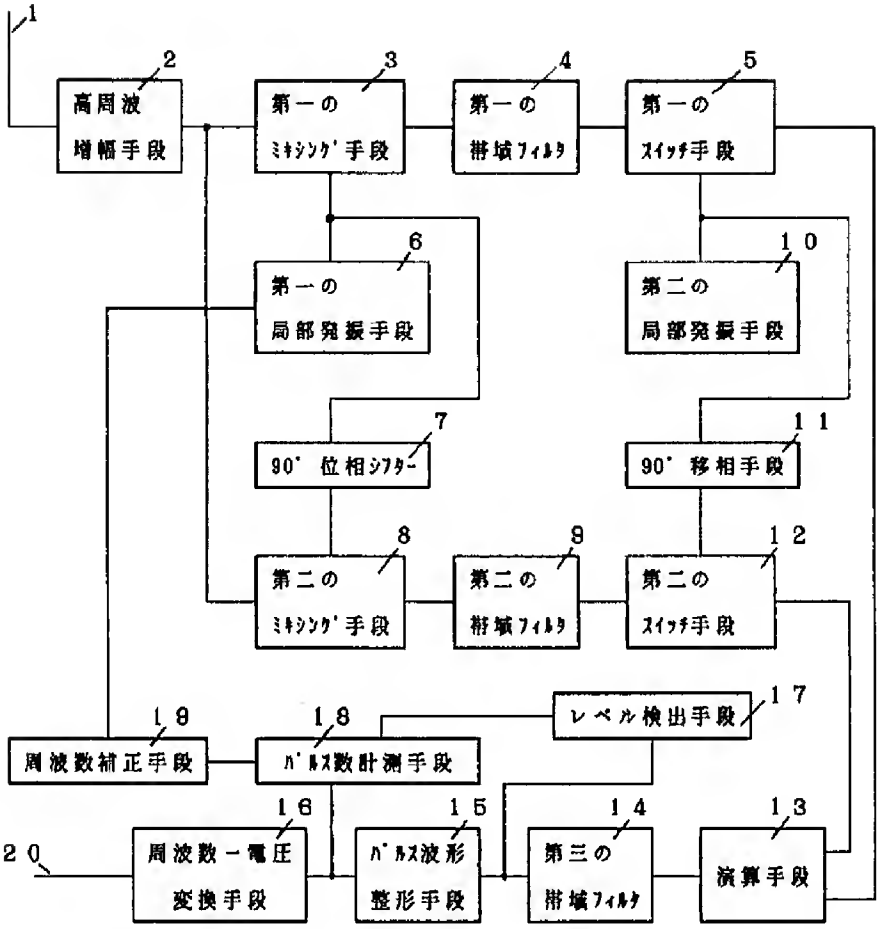
【符号の説明】

１　アンテナ
２　高周波増幅手段
３　第一のミキシング手段
４　第一の帯域通過フィルタ
５　第一のスイッチ手段
６　第一の局部発振手段
７　９０°位相シフター
８　第二のミキシング手段
９　第二の帯域通過フィルタ
１０　第二の局部発振手段
１１　９０°位相手段
１２　第二のスイッチ手段
１３　演算手段
１４　第三の帯域通過フィルタ
１５　パルス波形整形手段
１６　周波数－電圧変換手段
１７　レベル検出手段
１８　パルス数計測手段
１９　周波数補正手段
２０　出力端子
２１　時間計測手段

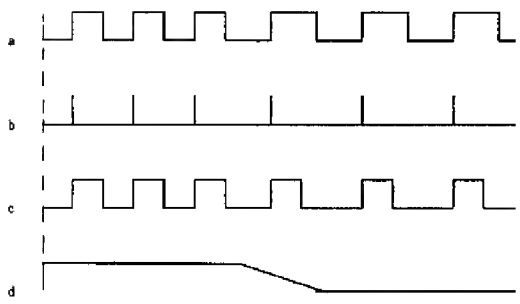
【図４】



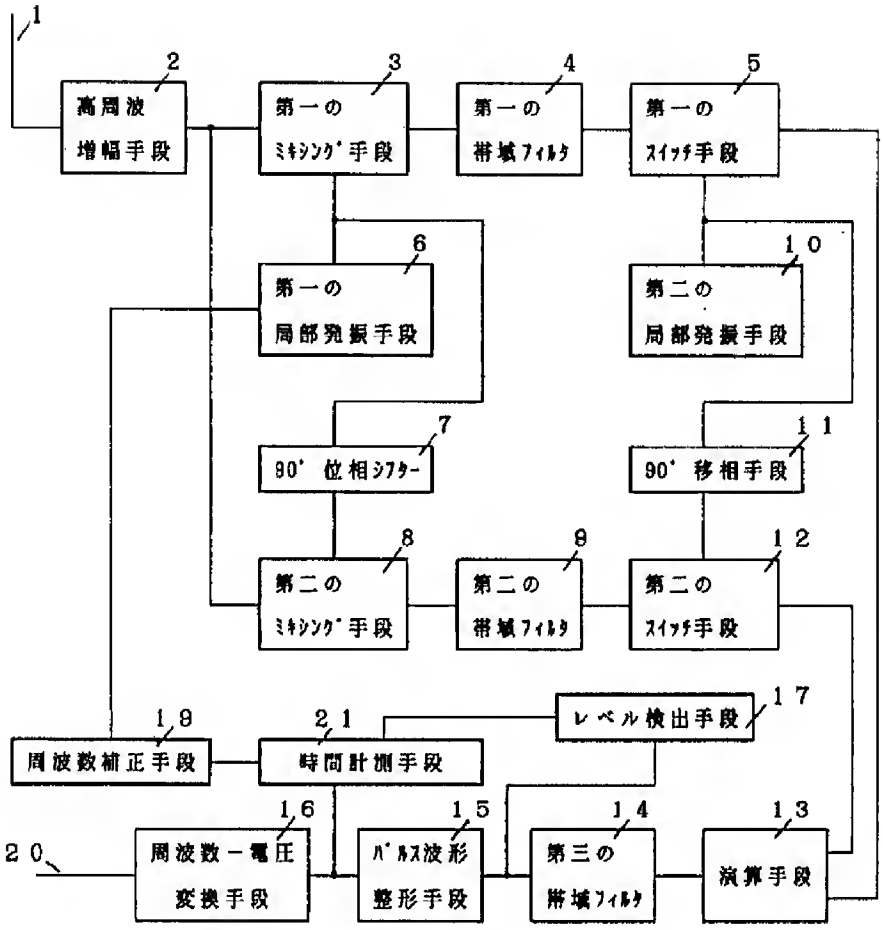
【図1】


1
2
高周波増幅手段
3
第一のミキシング手段
4
第一の帯域フィルタ
5
第一のスイッチ手段
6
第一の局部発振手段
10
第二の局部発振手段
7
90° 位相シフター
11
90° 移相手段
8
第二のミキシング手段
9
第二の帯域フィルタ
12
第二のスイッチ手段
17
レベル検出手段
19
周波数補正手段
18
パルス数計測手段
16
周波数－電圧変換手段
15
パルス波形整形手段
14
第三の帯域フィルタ
13
演算手段
20

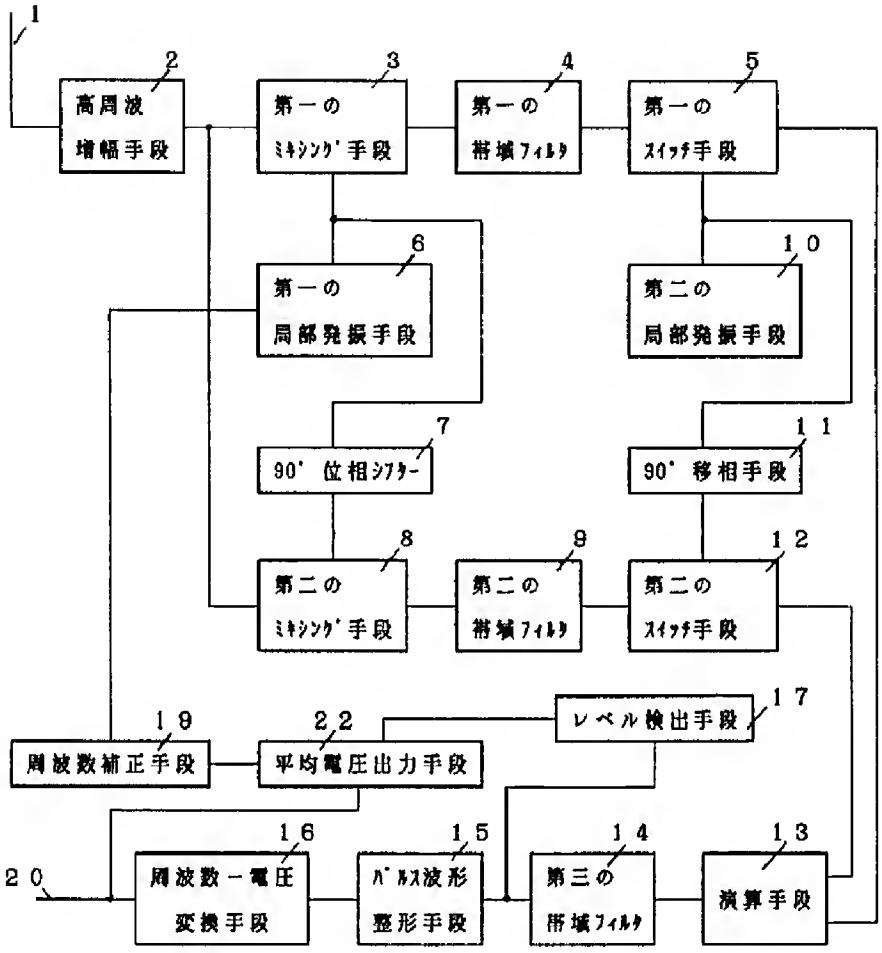
【図5】


a
b
c
d

【図２】


1
2
高周波
増幅手段
3
第一の
ミキシング手段
4
第一の
帯域フィルタ
5
第一の
スイッチ手段
6
第一の
局部発振手段
10
第二の
局部発振手段
7
90° 位相シフター
11
90° 移相手段
8
第二の
ミキシング手段
9
第二の
帯域フィルタ
12
第二の
スイッチ手段
17
レベル検出手段
19
周波数補正手段
21
時間計測手段
16
周波数－電圧
変換手段
15
パルス波形
整形手段
14
第三の
帯域フィルタ
13
演算手段
20

【図３】



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